Humanizing the Earth

The 1972 B. Y. Morrison Memorial Lecture

AGRICULTURAL RESEARCH SERVICE · U.S. DEPARTMENT OF AGRICULTURE

The B. Y. Morrison Memorial Lectureship was established by the Agricultural Research Service of the U.S. Department of Agriculture to recognize outstanding accomplishments in the science and practice of ornamental horticulture and other environic sciences . . . to encourage their wider application to improve the quality of life . . . and to stress the urgency of preserving and enhancing natural beauty in man's surroundings.

Lecturers meeting these standards of achievement and capable of giving effective voice to vital environmental messages are chosen from nominations submitted to a formal selection panel established by the Department. Nominations are obtained from scientific societies and other professional associations, foundations, universities, and previous Lecturers. Each platform is selected to provide a distinguished audience, and to promote an exchange of ideas among leaders working to improve our environment. The texts of these Lectures frequently are reprinted in popular and professional publications.

B. Y. Morrison (1891–1966) was a many-faceted man—a scientist, landscape architect, administrator, plant explorer, author, and lecturer. A pioneer in ornamental horticulture, he was the first Director of the National Arboretum, today one of the world's great botanic research and education centers. He gave the American public dozens of new ornamental plants, including the well-known Glenn Dale azaleas. He did much to advance the science of botany in the United States.

Morrison's plant exploration trips to the Orient, Europe, and Latin America made him a nationally known authority on foreign plants. He was one of the first Department officials to encourage introduction of ornamentals. His popular publications were among the first to promote plants to enhance the beauty of the land.

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Humanizing The Earth

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How gray and drab, unappealing and insignificant, our planet would be without the radiance of life. If it were not covered with living organisms, the surface of the earth would resemble that of the moon. Its colorful and diversified appearance is largely the creation of microbes, plants, and animals which endlessly transform its inanimate rocks and gases into an immense variety of organic substances. Man augments still further this diversification by altering the physical characteristics of the land, changing the distribution of living things, and adding human order and fantasy to the ecological determinism of nature.

Many of man's interventions into nature have, of course, been catastrophic. History is replete with ecological disasters caused by agricultural and industrial mismanagement. The countries which were most flourishing in antiquity are now among the poorest in the world. Some of their most famous cities have been abandoned; lands which were once fertile are now barren.

Disease, warfare, and civil strife have certainly played important roles in the collapse of ancient civilizations; but the primary cause was probably the damage caused to the quality of the soil and to water supplies by poor ecological practices. Similarly today, the environment is being spoiled in many parts of the world by agricultural misuse or overuse, by industrial poisoning, and by wars.

The primary purpose of the recent U.N. Conference on the Human Environment, held in Stockholm last June, was to formulate global approaches to the correction and prevention of the environmental defects resulting from man's mismanagement of the earth. I shall not discuss the technical aspects of these problems but rather shall try to look beyond them and present facts suggesting that man can actually improve on nature. In my opinion, the human use of natural resources and of technology is compatible with ecological health, and can indeed bring out potentialities of the earth which remain unexpressed in the state of wilderness.

Does Nature Really Know Best?

The disastrous ecological consequences of many past and present human activities point to the need for greater knowledge and respect of natural laws. This view is succinctly expressed by Dr. Barry Commoner in his fourth law of ecology: "Nature knows best." I shall first discuss the limitations of this law.

When left undisturbed, all environments tend toward an equilibrium state, called the climax or mature state by ecologists. Under equilibrium conditions, the wastes of nature are constantly being recycled in the ecosystem, which becomes thereby more or less self-perpetuating. In a natural forest, for example, acorns fall to the ground and

are eaten by squirrels, which in turn may be eaten by foxes or other predators; the dead leaves and branches, the excrements of animals, are utilized by microbes, which return their constituents to the soil in the form of humus and mineral nutrients. More vegetation grows out of the recycled materials, thus assuring the maintenance of the ecosystem.

When applied to such equilibrated systems, the phrase "Nature knows best" is justified, but is in fact little more than a tautology. As used in this phrase, the word "nature" simply denotes a state of affairs spontaneously brought about by evolutionary adaptation resulting from feedbacks which generate a coherent system. There are no problems in undisturbed nature; there are only solutions, precisely because the equilibrium state is an adaptive state. But in a given area, there is usually more than one possible equilibrium state, and there is no evidence that the "natural" solution is necessarily the best or the most interesting solution. In fact, it is likely, as I shall illustrate later, that the symbiotic interplay between man and nature can generate ecosystems more diversified and more interesting than those occurring in the state of wilderness.

What is surprising is not that natural environments are self-sustaining and generally appear efficient but, rather, that many of them constitute clumsy solutions to ecological problems. Many of these solutions appear inadequate, even where nature has not been disturbed by man or by cataclysms, and therefore could have been expected to reach the optimum ecological state.

That the wisdom of nature is often short-sighted is illustrated by the many disasters that repeatedly affect plants and animals in their undisturbed native habitats. The repeated population crashes [*periods of heavy mortality*] among animal species such as lemmings, muskrats, or rabbits result from the defectiveness in the natural

mechanisms which control population size. These crashes unquestionably constitute traumatic experiences for the animals, as indicated by the intense behavioral disturbances which often occur among them long before death. The crashes constitute, at best, clumsy ways of reestablishing an equilibrium between population size and local resources. Judging from the point of view of lemmings, muskrats, and rabbits—let alone human beings—only the most starry-eyed Panglossian optimist could claim that nature knows best how to achieve population control.

Most surprising is the fact that, even without environmental changes caused by human interference or accidental cataclysms, nature fails in many cases to complete the recycling processes which are considered the earmarks of ecological equilibrium. Examples of such failures are the accumulation of peat, coal, oil, shale, and other deposits of organic origin. These materials are largely derived from the bodies of plants and other living things that have become chemically stabilized after undergoing only partial decomposition. The very fact that they have accumulated in fantastic amounts implies that they have not been recycled. Pardoxically, man helps somewhat in the completion of the cycle when he burns peat, coal, or oil, because he thereby makes the carbon and minerals of these fuels once more available for plant growth. The trouble with this form of recycling is that the breakdown products of the fuels are so rapidly put back into circulation through air, water, and soil that they overload contemporary ecological systems.

The accumulation of guano provides another example of recycling failure on the part of nature. This material, now used as a fertilizer, consists of the excrements deposited by birds on certain islands and cliffs. For example, millions of sea birds use the Chincha Islands off the coast of Peru as a resting place and breeding ground; their droppings,

accumulated through centuries or perhaps millennia, have formed layers of guano from 60 to 100 feet thick. Guano, being rich in nitrogen, phosphate, and potash, constitutes an ideal fertilizer, and its accumulation therefore represents a spectacular example of recycling failure. Here again, man completes the recycling process by collecting guano and transporting it to agricultural fields where it reenters the biological cycle in the form of plant nutrients.

Just as it is erroneous to claim that nature has no waste, so it is erroneous to claim that it has no junkyards. The science of paleontology is built from the wastes and artifacts casually abandoned by primitive man. Admittedly, the accumulation of solid wastes in technological societies is evidence of a massive failure of recycling for which man is responsible. But this ecological failure is the expression of behavioral characteristics that have always existed in human nature. Like the great apes, primitive man was wasteful and careless of his wastes, and we have remained so throughout history.

The solid waste problem has become grave in our times because we produce more wastes than in the past, and what we reject is commonly of a chemical composition not found in natural ecosystems. Nature does not know how to deal with situations that have no precedents in the evolutionary past. The solution to the problem of solid wastes, therefore, cannot be found in the ways of nature. It requires new technological methods and changes in the innate or natural behavior of man.

Manmade Lands

Hailstorms, droughts, hurricanes, earthquakes, volcanic eruptions are common enough to make it obvious that the natural world is not the best possible world; man is not

responsible for these disasters, but he suffers from them as do other living things. Of greater interest, perhaps, is the fact that nature is incapable, by itself, of fully expressing the diversified potentialities of the earth. Many richnesses of nature are brought to light only in the regions that have been humanized: agricultural lands, gardens, and parks have to be created and maintained by human toil.

Until man intervened, much of the earth was covered with forests and marshes. There was grandeur in this seemingly endless green mantle, but it was a monotonous grandeur chiefly derived from immensity and uniformity. The primeval forest almost concealed the underlying diversity of the earth. This diversity was revealed by man in the process of producing food and creating his civilizations. Since an extensive analysis of the creative transformations of the earth by man would be impossible here, I shall illustrate it with one single example, namely, that of the part of France where I was born and raised.

Before human occupation, the Ile de France [*the area around Paris*] was a land without any notable characteristics. The hills have such low profiles that they would be of little interest without the venerable churches and clusters of houses that crown their summits. The rivers are sluggish and the ponds muddy, but their banks have been adapted to human use and their names have been celebrated so often in literature that they evoke the enchantment of peaceful rural scenes. The sky is rarely spectacular, but painters have created a rich spectrum of visual and emotional experiences from its soft luminosity.

Ever since the primeval forest was cleared by Neolithic settlers and medieval farmers, the province of the Ile de France has retained a humanized charm which transcends its natural endowments. To this day, its land has remained very fertile, even though part of it has been in continuous use for more than two thousand years. Far from being

exhausted by intensive agriculture over such long periods of time, the land still supports a large population and a great variety of human settlements.

What I have just stated about the Ile de France is, of course, applicable to many other parts of the world. Ever since the beginning of the agricultural revolution during the Neolithic period, settlers and farmers have been engaged all over the world in a transformation of the wilderness. Their prodigious labors have progressively generated an astonishing diversity of manmade environments, which have constituted the settings for most of human life. A typical landscape consists of forested mountains and hills serving as a backdrop for pastures and arable lands, villages with their greens, their dwellings, their houses of worship, and their public buildings. People now refer to such a humanized landscape as "nature," even though most of its vegetation has been introduced by man and its environmental quality can be maintained only by individualized ecological management.

Just as nature has not been capable by itself of giving full expression to the potential diversity of our globe, likewise it is not capable of maintaining manmade environments in a healthy state. Now that so much of the world has been humanized, environmental health depends to a very large extent on human care. Forests must be managed, swampy areas which are under cultivation must continually be drained, the productivity of farmlands must be maintained by crop rotation, irrigation, fertilization, and destruction of weeds. From historical times, the Campagna Romana [*area around Rome*] has been infested with mosquitoes and devastated by malaria every time men have lacked the stamina to control its marshes. Similarly, farmlands that have been economically productive and esthetically attractive for a thousand years are invaded by brush and weeds as soon as farmers neglect to cultivate them. The

rapid degradation of abandoned gardens, farmlands, and pastures is evidence that humanized nature cannot long retain its quality without human care.

Ecology, Energy, and Agriculture

It is true that many ancient civilizations have ruined their environment and that a similar process is going on now in certain highly industrialized areas, but this is not inevitable. Intensive agriculture has been practiced for a thousand years in certain lands without decreasing their fertility or ruining their scenery. Man can create artificial environments from the wilderness and manage them in such a manner that they long remain ecologically stable, economically profitable, esthetically rewarding, and suited to his physical and mental health. The immense duration of certain manmade landscapes contributes a peculiar sense of tranquility to many parts of the Old World; it inspires confidence that mankind can act as steward of the earth for the sake of the future.

Lands could not remain fertile under intense cultivation unless managed according to sound ecological principles. In the past, these principles emerged empirically from practices that assured the maintenance of fairly high levels of humus in the soil. But scientific knowledge of soil composition and texture, of plant physiology, and of animal husbandry is providing a new basis for agricultural management. During the past century, the sound empirical practices of the past have been progressively replaced by more scientific ones, which include the use of artificial fertilizers and pesticides. Scientific agriculture has thus achieved enormous yields of plant and animal products. Furthermore, experimental studies have revealed that many types of lands can remain fertile for long periods of time

without organic manure, provided they are continuously enriched with chemical fertilizers in amounts and compositions scientifically determined.

Efficiency, however, cannot be measured only in terms of agricultural yields. Another criterion is the amount of energy (measured in calories) required for the production of a given amount of food. And when scientific agriculture is judged on this basis, its efficiency is often found to be very low. Paradoxical as this may sound, there are many situations in which the modern farmer spends more industrial calories than he recovers in the form of food. His caloric expenditure consists chiefly of gasoline for powering his equipment and of electricity for producing chemical fertilizers and pesticides—let alone the caloric input required to irrigate the land and to manufacture tractors, trucks, and the multifarious kinds of machines used in modern farming.

Needless to say, modern civilizations would be inconceivable if the energy (calories) now required by agriculture had to come from human muscles instead of from gasoline and electricity. But it is a fact, nevertheless, that if fossil fuels were to remain the most important source of power, the sheer size of the world population would make it impossible to continue for long the energy deficit spending on which agriculture depends in prosperous industrialized countries. And there would be no hope of extending these modern agricultural practices to the developing countries, which constitute the largest part of the world.

No matter how the situation is rationalized, the present practices of scientific agriculture are possible only as long as cheap sources of energy are available. After the world supplies of fossil fuels have been exhausted, the modern farmer, like the modern technologist, will become ineffective unless energy derived from nuclear reactions, geothermal

sources or solar radiation can be supplied in immense amounts at low cost. Thus, the future of land management is intimately bound to the development of new sources of energy, as are all other aspects of human life.

Between Man and the Earth

Of the 70 to 100 billion people who have walked the surface of the earth since *Homo sapiens* acquired his biological identity, by far the largest percentage have lived on the manmade lands that have been created since the agricultural revolution.

In every part of the world, the interplay between man and nature has commonly taken the form of a true symbiosis—namely a biological relationship which alters somewhat the two components of the symbiotic system in a way that is beneficial to both. Such transformations, achieved through symbiosis, account in large part for the immense diversity of places on earth and for the fitness between man and environment so commonly observed in areas that have been settled and have remained stable for long periods of time.

Furthermore, the reciprocal transformations of man and environment have generated a variety of situations, each with its own human and environmental characteristics. For example, the agricultural techniques, social policies, and behavioral patterns in the various islands of the South Pacific are determined not only by geologic and climatic factors but even more by the cultural attitudes of the early settlers—Polynesians, Melanesians, or Indonesians—and then later of the Western and Oriental people who colonized the islands. Cultural attitudes, more than natural conditions, are responsible for the profound differences between Fiji, Tahiti, and the Hawaiian islands. The Pacific islands were initially settled by different groups of people and, in

addition to these early human influences, they exhibit today the more recent influences respectively of their English, French, or American colonizers.

The shaping of nature by culture can be recognized in many other parts of the world. As the process of humanization of the earth continues, however, it will increasingly be influenced by the fact that most of the globe will soon be completely occupied and utilized. This colonization process began, of course, long before the days of modern technology. But the difference is that men now occupy and utilize all land areas except those that are too cold, too hot, too dry, too wet, too inaccessible, or at too high an altitude for prolonged human habitation.

According to the U.N. Food and Agricultural Organization (FAO), practically all the best lands are already farmed; future agricultural developments are more likely to result from intensification of management than from expansion into marginal lands. There probably will be some increase in forest utilization but, otherwise, land use will soon be stabilized. In fact, expansion into new lands has already come to an end in most developed countries and is likely to be completed within a very few decades in the rest of the world. A recent FAO report states the probable final date as 1985.

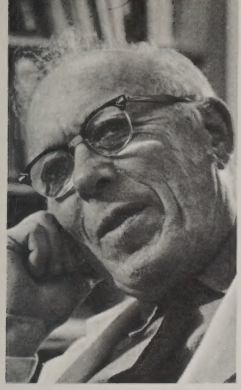
The U.N. Conference on the Human Environment, therefore, came at a critical time in man's history. Now that the whole earth has been explored and occupied, the new problem is to manage its resources. Careful management need not mean stagnation. As already mentioned, in many places the interplay between man and nature results in a creative symbiotic relationship that facilitates evolutionary changes. Man continuously tries to derive from nature new satisfactions that go beyond his elementary biological needs—and he thereby gives expression to some of nature's potentialities that would remain unrecognized without his efforts.

Wilderness and Humanized Earth

Man has now succeeded in humanizing most of the earth's surface but, paradoxically, he is developing simultaneously a cult for wilderness. After being frightened for so long by the primeval forest, he has come to realize that its eerie light evokes in him a mood of wonder that cannot be experienced in an orchard or a garden. Likewise, he recognizes, in the vastness of the ocean and in the endless ebb and flow of its waves, a mystic quality not found in humanized environments. His response to the thunderous silence of deep canyons, the solitude of high mountains, the luminosity of the desert, is the expression of an aspect of his fundamental being that is still in resonance with cosmic events.

As mentioned earlier, nature is not always a good guide for the manipulation of the forces that affect the daily life of man; but undisturbed Nature knows best—far better than ordinary human intelligence—how to make men aware of the cosmos and to create an atmosphere of harmony between him and the rest of creation.

Humanizing the earth thus implies much more than transforming the wilderness into agricultural lands, pleasure grounds, and healthy areas suitable for the growth of civilization. It also means preserving the kinds of wilderness where man can experience mysteries transcending his daily life, and also recapture direct awareness of the cosmic forces from which he emerged. It is obvious, however, that man spends his daily life not in the wilderness but in environments that he creates—in a manmade nature. Let me restate in conclusion my belief that by using scientific knowledge and ecological wisdom we can manage the earth so as to create environments which are ecologically stable, economically profitable, esthetically rewarding, and favorable to the continued growth of civilization.



René Dubos, Professor Emeritus of The Rockefeller University, New York City, is a microbiologist and experimental pathologist. Born in France, Dr. Dubos came to the United States to study bacteriology in 1924; he became an American citizen in 1938. Trained in agricultural science at the Institut National Agronomique in Paris, he was awarded his Ph. D. by Rutgers University in 1927. Since then, until his retirement in 1971, he has been a faculty member of The Rockefeller University except for 2 years when he was Professor of Tropical Medicine at Harvard University.

In 1929, he isolated a soil microbe enzyme which could destroy the protective capsule of pneumococcus, the germ responsible for lobar pneumonia. Dr. Dubos' work generated a ground swell as the medical world came to realize the importance of commonly occurring microbes in the treatment of disease. This recognition led to the practical use of such drugs as penicillin and streptomycin.

Dr. Dubos maintains that mankind confronts the challenges of today with anachronistic biological equipment. He holds that many forms of organic and mental disease and many peculiarities in man's responses to stress originate from the paleolithic physiology with which humans must face the conditions of modern life.

Dr. Dubos' numerous works include the Pulitzer Prize winning *So Human an Animal* (1968) and *A God Within*, published last year.

He has received honorary degrees from 26 institutions of higher learning and many awards including, most recently, the $50,000 Institute of Life Prize.

Previous Lecturers

1968 Mrs. Lyndon B. Johnson
addressed the American Institute of Architects in Portland, Oreg.

1969 Mr. Patrick Horsbrugh,
Professor of Architecture and creator of the Graduate Program in Environic Studies at Notre Dame University,
addressed the General Federation of Women's Clubs in Cleveland, Ohio.

1970 Dr. Arie Jan Haagen-Smit,
California Institute of Technology, Pasadena,
addressed the American Society of Landscape Architects in Williamsburg, Va.

1971 Mr. Ian L. McHarg,
Chairman of the Graduate Department of Landscape Architecture and Regional Planning at the University of Pennsylvania,
addressed the Thirty-sixth North American Wildlife and National Resources Conference in Portland, Oreg.

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